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Quantification of accessibility to health facilities in rural areas

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ABSTRACT

The accessibility to medical facilities plays an important role in the overall health system of a country. Accessibility often refers to spatial or physical accessibility and is concerned with the complex relationship between the spatial separation of the population and the supply of health care facilities. There is a need to understand the current health care needs and also the existing practices. The traditional planning approach for rural transportation believes that building roads would ensure access to various infrastructure and services by motorized vehicles. However the impacts of such investments on rural development and also on health care have been found to be extremely mixed. Therefore an attempt has been made to quantify the impact of such investments on health sector. Prime Minister Gram Sadak Yojana (PMGSY) program, an Indian Government initiative is an example of one such investment. The accessibility to medical facilities of the villages connected by PMGSY roads is compared to villages which are not connected by any means, so that the effect on accessibility in the presence of a well constructed road can be determined. Quantifying accessibility in terms of health care contributes to a wider understanding of the performance of the health systems which in turn helps the policy decision maker(s) in identifying the deficiencies of the system so that remedial measures could be taken. However, it would be incomplete if the distance (or travel time), quality of service provided at the health care center and affordability of the users are not considered while quantifying accessibility. Therefore by integrating all the important factors influencing accessibility along with multi criteria decision making tools, a methodology is developed. This methodology includes three different multi-criteria decision making analysis tools: Simple Additive Weightage (SAW), Fuzzy aggregation method and Fuzzy preference decision analysis. Further these three methods are critically analyzed for their suitability to quantify accessibility to medical facilities.

1. Introduction

Access to health is one of the basic needs for a country and it might be defined in terms of the ability of a population to receive appropriate, affordable and quality medical facilities when needed. In the rural areas, especially in a vast country such as India the medical facilities are sparsely distributed and construction of roads does not always ensure better accessibility. Thus while the road development programs are taken up in a region it is necessary also to determine the impact on the accessibility to basic facilities. Till a few years ago, India did not have a nation-wide program on the construction of rural roads and mostly earth or gravel roads were constructed at the lowest government level with meager funding and thus there was not much scope to study the impact of such roads on accessibility. In 2000, for the first time, the Government of India had initiated a program solely for rural road development, popularly known as Prime Minister Gram Sadak Yojana (PMGSY), the objective of which was to connect all the villages having population over 500 in plain areas and over 250 in hilly and desert regions by the end of 2007. The target could not be achieved in time and thus the program is still continuing. It is widely accepted that these roads have improved social, physical, financial and human capital of the population of the connected villages (Sarkar, 2007). However, no study has yet been reported on the determination of the impact of these roads on the accessibility to health care facilities.

To evaluate the impact of PMGSY roads on accessibility to health facilities, studies were conducted in two set of villages, one connected by PMGSY roads and the other one unconnected by any all-weather road. Also to include the effect of region and

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geography, two separate studies were conducted, one in plain agricultural area in Alwar district and the other in a desert region in Churu district. Both the districts are in the state of Rajasthan. The objective of the study was to quantify the level of accessibility to health facilities and three multi-criteria decision making tools have been used, namely simple additive weightage (SAW), fuzzy aggregation method and fuzzy preference decision analysis and the results have been compared.

2. Review of literature

Physical isolation is one of the important factors for increase in mortality rate. Joseph and Phillips (1984) has stated that among the many factors that influence access to health care services, two of them are critical: physician supply and population demand. Several applications of physical accessibility to different kinds of health care facilities both in developed and developing countries have been carried out by Parker and Campbell (1998), Guagliardo (2004), Luo (2004) and Noor et al. (2004). A number of studies have been carried out on the use of GIS for measuring physical accessibility to basic needs such as health care by Lee (1995), Wilkinson et al. (1998), Albert et al. (2000) and Cromley and McLafferty (2002). Luo (2004) have stated that good primary care can prevent or reduce unnecessary expensive specialty care. US Federal register (2000), administrated by the Department of Health and Human Services (2000), Lee (1999) have developed certain criteria's for identifying shortage areas, which mainly depends on two systems. One designates health professional shortage areas (HPSAs), the other medically underserved areas or populations (MUAs/MUPs). A summary of the historical development of the two systems can be found in Ricketts et al. (2007). In India while applying Integrated Rural Accessibility Planning (IRAP), attempts have been made by ILO ASIST AP (2003), Donnges (1998), Donnges et al. (2004), Sarkar (2005), Sarkar and Ghosh (2008) to develop simple techniques to measure accessibility to various sectors in rural areas of many developing countries that are being used for helping the local government representatives to prioritize the needs and taking decisions accordingly. Predominantly of all the sectors, lots of efforts have been made to improve accessibility to health care sector.

In developing countries like India usually availability of public transport in rural areas is inadequate which severely affects the mobility of the residents. In the absence of facilities they need to depend mostly on personal and para-transit modes for getting access to basic facilities. Accessibility depends on travel time, travel cost, comfort, convince and the road condition and these parameters are difficult to quantify as they are fuzzy in nature. The concept of fuzzy sets was first introduced by Zadeh (1965). Since this introduction, it has been used in many areas related to human perception, such as the evaluation of service quality and the analysis of workload and risk in the workplace. Fuzzy sets, where a more flexible sense of membership is possible, are classes with un-sharp and vague boundaries. In decision making processes, several categorical criteria with differing levels of importance are used to evaluate alternatives. To evaluate the alternatives according to the stated criteria requires procedures that aggregate the result for each criterion across each subject. The information from those several categorical criteria should be aggregated. One of common aggregation method used is concept of the weighted average based on fuzzy set theory, which is called a fuzzy weighted average method. The fuzzy weighted average method was successfully used to quantify level of service of buses in India by Kanuganti et al. (2013). It is clear from the above literature that even though enough work has been done on determining physical accessibility to health care by various researchers, no attempt has been made to study the effectiveness of both travel characteristics and quality of services with respect to each individual in rural environment. The quantification of effectiveness of travel characteristics and quality of services with respect to each individual may be better studied using multi-criteria decision analysis. Hence, an attempt has been made in the present study to quantify the level of accessibility to health facilities and three multi-criteria decision making tools have been used, namely simple additive weightage (SAW), fuzzy aggregation method and fuzzy preference decision analysis.

3. Objectives

It is well acknowledged that the impact of providing better accessibility through the construction of roads, have both long-term and short-term effects on the health of the community. The study has helped to understand the health care needs and the existing practices of meeting them in the study area with special reference to maternal health. Very often there are suppressed demands for attending health centers in the absence of quality service and/or lack of mobility. Also, the mobility, particularly of women, might be affected due to cultural restrictions. The study has brought out all such issues including the role of transport and transport-related barriers in accessing health facilities. This helped in understating how the constraints on mobility affect the health of poor men and women establishing the relationship between mobility and health. The objectives of the paper are:

- To identify the parameters to be considered to determine the level of accessibility to medical facilities in rural areas.
- To arrive alternative indices using multi-criteria analysis for quantifying the level of accessibility individual villages.
- To compare the results of all the alternative approaches to determine their strengths and weaknesses and to identify the most suitable one.

The alternative approaches are to be tested in a few case studies in Rajasthan. Cluster of villages, both connected by PMGSY roads and unconnected would be considered for detailed analysis.

4. Methodology

The accessibility to a facility or service depends on many parameters such as distance, travel time, travel cost, ownership of vehicles, availability and quality of public transport services, kind and quality of roads and many others. The parameters to be considered for assessing accessibility may vary with the purpose of the trip. Thus it is difficult to comprehend and compare the accessibility levels among villages by using subjective descriptions. At first a simple technique has been suggested to quantify accessibility to health so that the existing situations could be compared among villages. A simple additive method (SAW) is a conventional weighted average method used to calculate final scores. But in many research studies, user perceptions of certain subjects are evaluated using linguistic scales with a various numbers of descriptors. Accordingly two other methods, namely fuzzy aggregation method and fuzzy preference decision analysis (Singh and Vidyarthi, 2008; Singh and Dubey, 2012) have also been used for determining the level of accessibility.

4.1. Simple additive weightage method

A simple technique for the quantification of accessibility has been suggested in this study by which the accessibility to different levels of health care facilities of each village could be quantified based on selected parameters and existing conditions. This would help to compare the levels of accessibility between connected and unconnected villages. It might be noted that the levels of accessibility calculated using this technique are not fuzzy values